DIAGNOSTIC ACCURACY OF CORONARY CT IN SURVIVORS OF OUT-OF-HOSPITAL CIRCULATORY ARREST: CAN CT SERVE AS A GATEKEEPER FOR INVASIVE CORONARY ANGIOGRAPHY?

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PRESENTER DISCLOSURE INFORMATION

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Diagnostic Accuracy of Coronary CT in Survivors of Out-Of-Hospital Circulatory Arrest

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WHY CT FOR SUDDEN DEATH SURVIVORS?

- Estimated 10-50% of out-of-hospital circulatory arrests (OHCA) are due to a coronary artery disease (CAD)
- Prior studies suggested early invasive coronary angiography (ICA) ± coronary intervention improves outcomes in OHCA survivors
- The COACT randomized trial showed similar outcomes to early versus delayed ICA in OHCA survivors
- Urgent ICA may not be warranted in all survivors of OHCA

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Mushtaq F, Ritchie D. Emerg Med. 2005;22:718–21. Al-Khatib SM, et al. Circulation 2018;138:e272–e391. Yannopoulos D, et al. Circulation. 2019;139:e530–e552; Lemkes, JS, et al. N Engl J Med 2019; 380:1397-1407

WHY CT FOR SUDDEN DEATH SURVIVORS?

- ACC/AHA Guidelines: *In patients who have recovered from unexplained SCA, CT or invasive coronary angiography is useful to confirm the presence or absence of ischemic heart disease and guide decisions for myocardial revascularization (I;C-EO).*

- **Despite being part of the guidelines, coronary CT has not been prospectively evaluated in survivors of OHCA**

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CT FIRST CLINICAL TRIAL

CT FEASIBILITY IN RESUSCITATED PATIENTS FOR SUDDEN DEATH TRIAGE

We postulated that an early, head-to-pelvis ECG-gated CT angiogram (CT-First) in idiopathic sudden death survivors is feasible, safe, and improves the speed and accuracy for a correct patient diagnosis compared to standard care.

Primary Outcomes: Feasibility; Time to diagnosis; Diagnostic Accuracy

Safety Outcomes: Renal function; Erroneous CT findings

Pre-Specified Secondary Analysis:

Diagnostic accuracy of coronary CT angiography (CCTA) to detect obstructive coronary artery disease compared to ICA

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ClinicalTrials.gov Identifier: NCT03111043

CT FIRST: INCLUSION AND EXCLUSION

Inclusion Criteria:

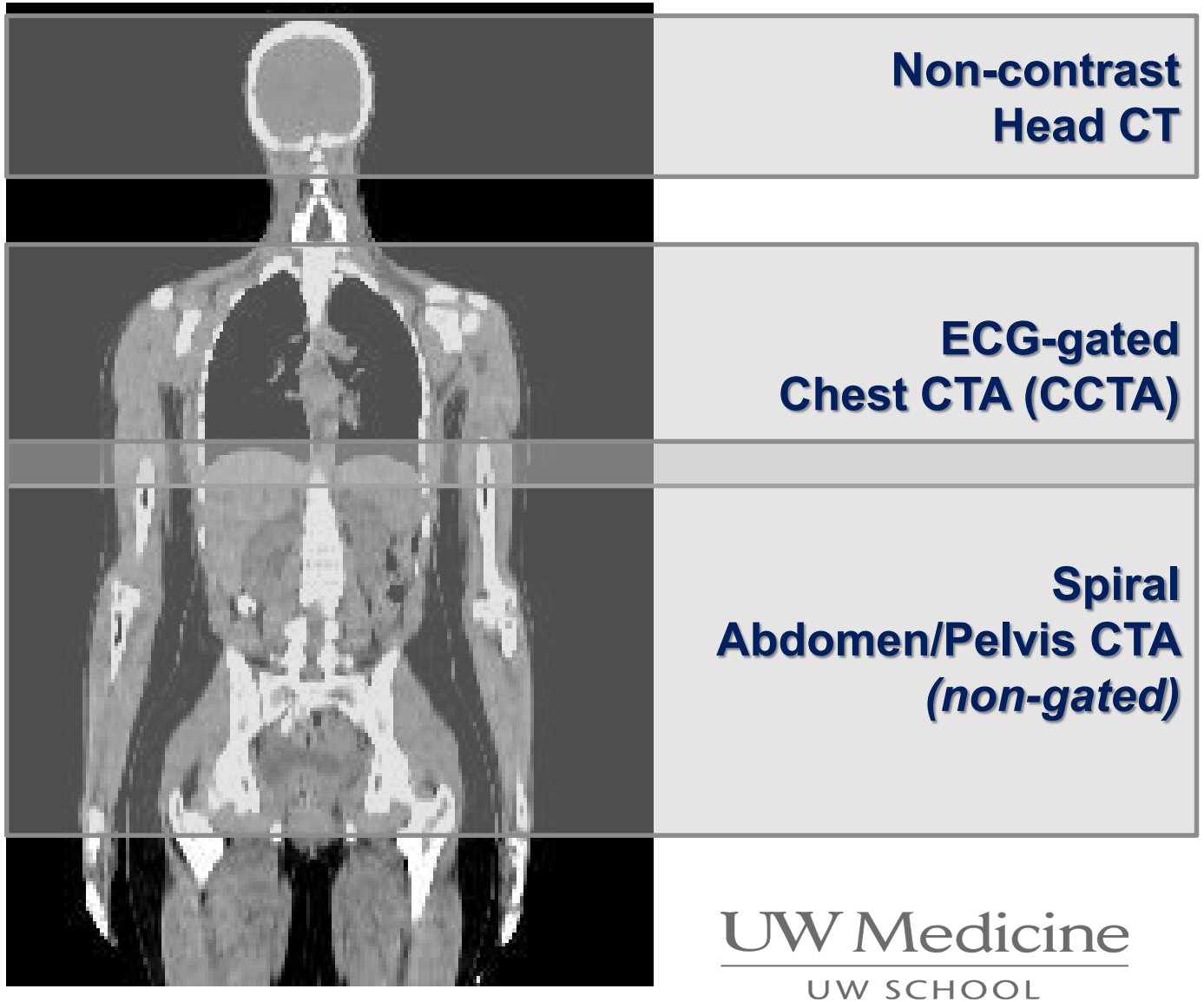
- Patients arriving to Emergency Department ≤ 6 hours from resuscitated OHCA event
- No obvious cause for OHCA event with initial standard of care, including drowning, suicide, drug overdose, or critical metabolic disorders
- Patient was clinically stable to have SDCT performed per the treating physician.
- *For substudy:* Underwent clinically ordered ICA

Exclusion Criteria:

- Acute ST elevation myocardial infarction (ST elevation ≥1 contiguous lead or new/unknown duration left bundle branch block on ECG) or indication for urgent invasive angiography by treating physicians
- Known non-revascularized coronary artery disease or coronary stent <2.5 mm
- Known severe renal dysfunction (eGFR<30 ml/hr, creatinine >1.7 mg/dl), unless treating physician ordered clinical SDCT
- Implantable defibrillator, due to metal artifact from defibrillator coil
- Known iodinated contrast allergy
- Known hospice patient or terminal disease with expected <3 months survival.

CT FIRST SUDDEN DEATH CT (SDCT) PROTOCOL

- Siemens FORCE or GE Revolution CT scanner
- *Cardiac CT Angiography (CCTA):*
  - Scanned entire cardiac cycle (0-100% R-R interval)
  - Automated mA, kVp settings
  - No optimization for coronary CT analysis (i.e., no beta blocker or NTG)
  - Coronary and cardiac findings blinded to treating physicians
- Other CT data could be used clinically



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CT FIRST: METHODS

- CCTA independently reviewed by CCTA-trained providers (K.B. and R.B., 15 and 2 years CCTA experience, respectively)
- Coronary quality and stenosis scored using 20 segment AHA model
  - Ordinal degree of stenosis: 0%, 1-29%, 30-49%, 50-69%, 70-99%, 100%
  - Discrepancies were resolved by consensus
- ICA scored similar to CCTA (R.H., 8 years ICA experience)
- Primary Analysis: Obstructive CAD threshold ≥50% stenosis and analyzed at patient and major coronary artery level
  - Exploratory analysis at ≥70% stenosis
- Non-evaluable segments were either 1) excluded or 2) assumed to have the highest degree of stenosis (*intention to scan*)

CT FIRST VS ICA – BASELINE CHARACTERISTICS

Characteristic (n=28)	N (%) or Mean ± SD
Age (years)	56±15
Race	
Caucasian	15 (54%)
Black	3 (11%)
Asian	3 (11%)
Other/Unknown	7 (25%)
Known medical history	25 (89%)
Coronary artery disease	6 (21%)
Coronary intervention	2 (7%)
Dyslipidemia	15 (16%)
Left ventricular dysfunction	7 (25%)
Diabetes mellitus	7 (25%)
Hypertension	16 (57%)
Renal dysfunction	4 (14%)
History of arrhythmia	5 (18%)
Atrial fibrillation	3 (11%)
Heart block	1 (4%)
History of cardiac arrest	1 (4%)

Characteristic	N (%)
Initial rhythm	
VF/VT	20 (71%)
Asystole	4 (14%)
Pulseless electrical activity	1 (14%)
Other/Unknown	3 (11%)
Witnessed arrest	15 (54%)
Bystander CPR	15 (54%)
Target Temperature Management	21 (75%)
Initial creatinine *(median, 95% CI)*	1.3 (1.1, 2.7)
Peak creatinine *(median, 95% CI)*	1.3 (1.3, 3.2)
Initial troponin *(mean±SD)*	0.15±0.18
Peak troponin *(mean±SD)*	2.1±4.9

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CT FIRST: CORONARY CTA VS INVASIVE ANGIOGRAPHY

Obstructive CAD if ≥50% stenosis

	N	Unevaluable N (%)	Diagnostic Accuracy % (95% CI)	Sensitivity % (95% CI)	Specificity % (95% CI)	Negative Predictive Value % (95% CI)	Positive Predictive Value % (95% CI)	ROC AUC (95% CI)
Patient Level	**28**	**0 (0%)**	**0.93 (0.77-0.98)**	**0.85 (0.58-0.96)**	**1.00 (0.80-1.00)**	**0.88 (0.66-0.97)**	**1.00 (0.74-1.00)**	**0.92 (0.80-1.00)**
Vessel level								
Left anterior descending	145	7/145 (5%)	0.94 (0.89-0.97)	0.64 (0.35-0.85)	0.97 (0.92-0.99)	0.97 (0.92-0.99)	0.64 (0.35-0.85)	--
Left circumflex	85	20/85 (24%)	0.97 (0.90-0.99)	0.80 (0.38-0.96)	0.98 (0.91-1.00)	0.98 (0.91-1.00)	0.80 (0.38-0.96)	--
Right coronary artery	116	22/116 (19%)	0.94 (0.87-0.97)	0.62 (0.36-0.82)	0.99 (0.93-1.00)	0.94 (0.87-0.98)	0.89 (0.57-0.98)	--

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Point estimates exclude non-evaluable segments. Point estimates are presented with 95% CI or as n/N.

CT FIRST: CORONARY CTA VS INVASIVE ANGIOGRAPHY

Obstructive CAD if ≥70% stenosis

	N	Unevaluable N (%)	Diagnostic Accuracy % (95% CI)	Sensitivity % (95% CI)	Specificity % (95% CI)	Negative Predictive Value % (95% CI)	Positive Predictive Value % (95% CI)	ROC AUC (95% CI)
Patient Level	**28**	**0 (0%)**	**0.86 (0.68-0.94)**	**0.69 (0.42-0.87)**	**1.00 (0.80-1.00)**	**0.79 (0.57-0.92)**	**1.00 (0.70-1.00)**	**0.85 (0.68-1.00)**
Vessel level								
Left anterior descending	145	7/145 (5%)	0.96 (0.91-0.98)	0.67 (0.35-0.88)	0.98 (0.93-0.99)	0.98 (0.93-0.99)	0.67 (0.35-0.88)	--
Left circumflex	85	20/85 (24%)	0.98 (0.92-1.00)	1.00 (0.44-1.00)	0.98 (0.91-1.00)	1.00 (0.94-1.00)	0.75 (0.30-0.95)	--
Right coronary artery	116	22/116 (19%)	0.96 (0.90-0.98)	0.70 (0.40-0.89)	0.99 (0.94-1.00)	0.97 (0.90-0.99)	0.88 (0.53-0.98)	--

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Point estimates exclude non-evaluable segments. Point estimates are presented with 95% CI or as n/N.

CT FIRST: CORONARY CTA VS INVASIVE ANGIOGRAPHY

Intention to Scan: Obstructive CAD if ≥50% stenosis

	N	Diagnostic Accuracy % (95% CI)	Sensitivity % (95% CI)	Specificity % (95% CI)	Negative Predictive Value % (95% CI)	Positive Predictive Value % (95% CI)	ROC AUC (95% CI)
Patient Level	**28**	**0.77 (0.59-0.86)**	**0.92 (0.67-0.99)**	**0.65 (0.41-0.83)**	**0.92 (0.65-0.99)**	**0.67 (0.44-0.84)**	**0.64 (0.44-0.84)**
Vessel level							
Left anterior descending	144	0.91 (0.85-0.95)	0.67 (0.39-0.86)	0.93 (0.88-0.96)	0.97 (0.92-0.99)	0.47 (0.26-0.69)	-
Left circumflex	81	0.85 (0.76-0.91)	0.91 (0.62-0.98)	0.84 (0.74-0.91)	0.98 (0.91-1.00)	0.48 (0.28-0.68)	-
Right coronary artery	107	0.82 (0.74-0.88)	0.62 (0.36-0.82)	0.85 (0.76-0.91)	0.94 (0.87-0.98)	0.36 (0.20-0.57)	-

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***Non-evaluable segments assumed to be obstructive**. Point estimates are presented with 95% CI or as n/N.*

CT FIRST: LIMITATIONS

- Small pilot study to two University hospitals
- Expertise in CCTA performance using latest generation scanners
- Not all phases of the cardiac cycle were available due to a data transfer error and this affected the coronary segmental accuracy
- ICA was ordered clinically which created a biased sample.
    - Balanced number of both positive and negative scans for CAD, which makes the accuracy data robust.

CT FIRST CCTA IN SUDDEN DEATH SURVIVORS - CONCLUSIONS

- In survivors of OHCA, ECG-gated CCTA, as part of a sudden death CT protocol, had high patient-level diagnostic accuracy to detect obstructive CAD compared to invasive coronary angiography
    - To our knowledge, these are the first data evaluating CCTA in this population
- **These prospective pilot data show promise that the CCTA portion of a SDCT protocol could serve as a gatekeeper for invasive coronary angiography**
    - The number of non-evaluable coronary segments are high suggesting further CCTA refinement is needed
- Future directions include a comparator cohort for outcomes as well as planning for a multicenter trial

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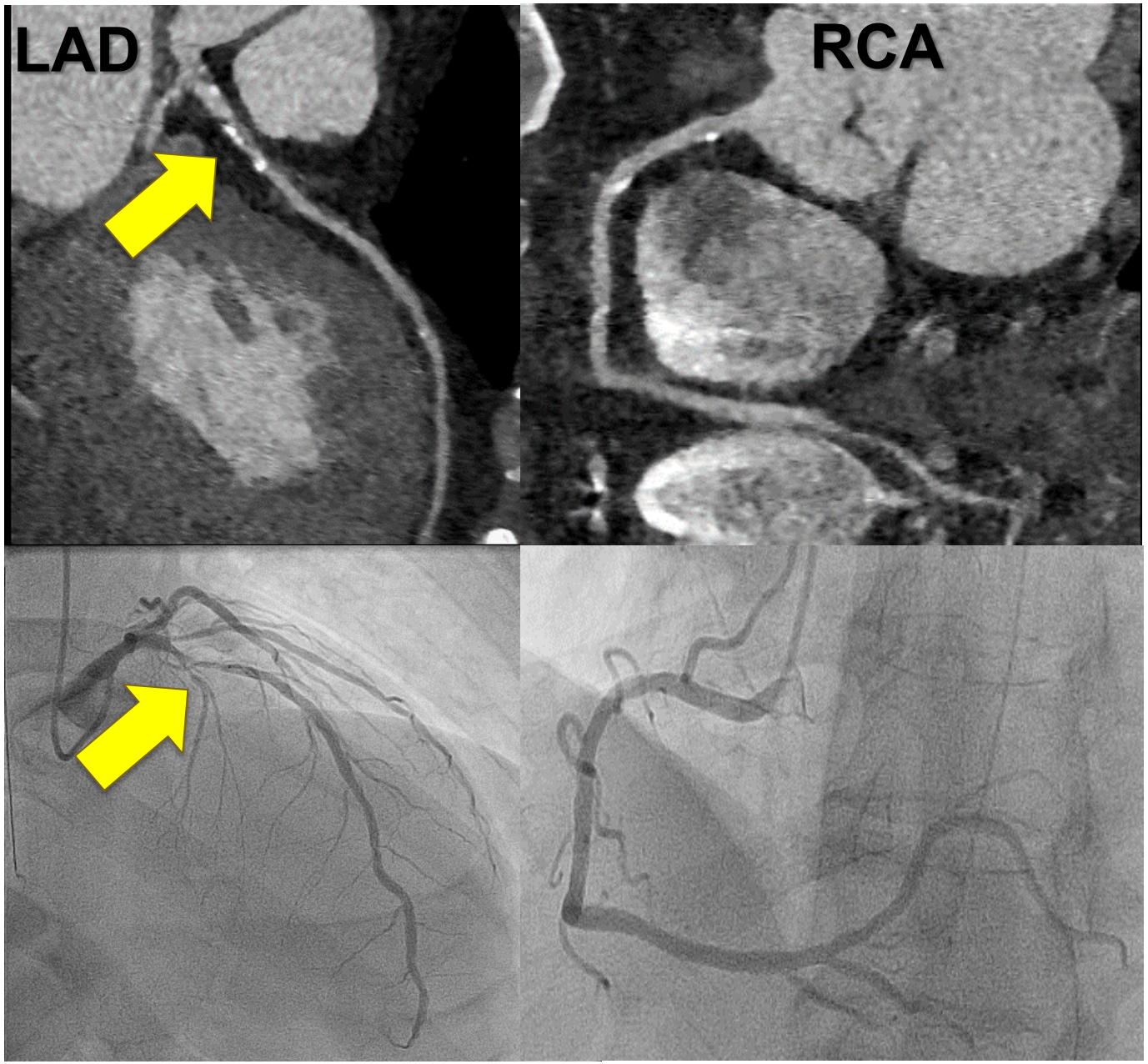
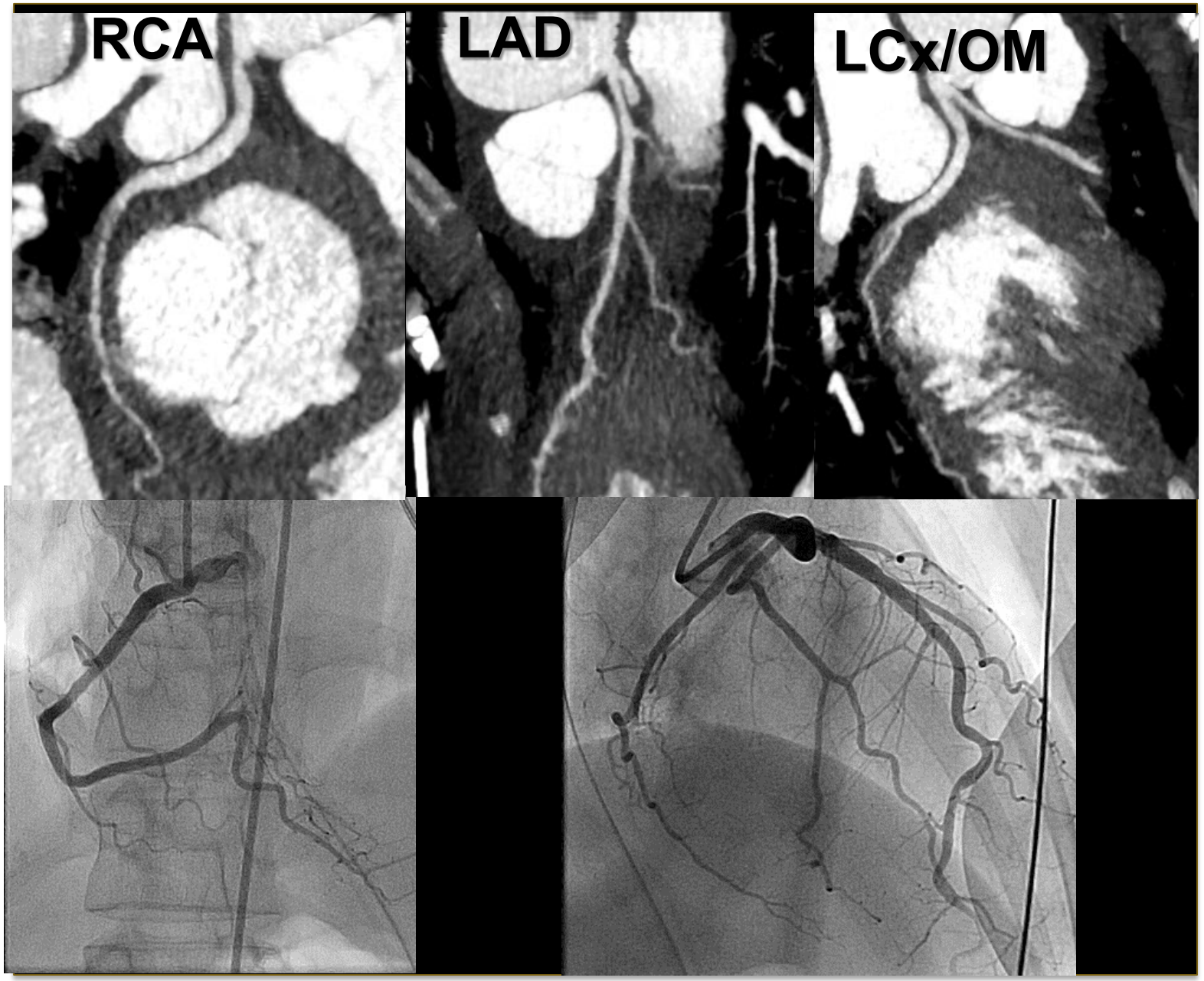


- 61 M with HTN and HLD, no known CAD, had a witnessed VF arrest at work.
- Bystander CPR and was shocked by an AED on site. and had further shocks and epi once EMS arrived with ROSC.
- EKG with dynamic ST changes.
- Urgently taken to ICA after SDCT.
- 70-99% mid LAD stenosis (arrows). No other obstructive CAD

LAD = left anterior descending artery; RCA = right coronary artery



- ** yo F with HTN had a witnessed VF arrest.
- No bystander CPR. Shocked x4 by EMS with ROSC.
- EKG with equivocal ST elevation
- Urgently taken to ICA after SDCT.
- No obstructive CAD

LCx/OM = left circumflex/obtuse marginal artery; LAD = left anterior descending artery; RCA = right coronary artery

CT FIRST: SAFETY

CT ICA

Total Contrast:

Radiation:

Baseline elevated creatinine:

Contrast nephropathy:

New renal replacement therapy: